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Effectiveness of Light Therapy on Depression, Biophysiological and Biochemical Parameters Among Adult Depressive Patients

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Abstract: **Introduction:** Depression is a pervasive mental health disorder characterized by persistent feelings of sadness, loss of interest, and diminished cognitive function. **Method:** The study, approved by the institutional ethics committee, used a quasi-experimental pretest-posttest control group design with a sample size of 150 participants, determined by power analysis. Seventy-five participants were assigned to the experimental group, and 75 to the control group, all meeting the inclusion criteria for depressive disorders. Inclusion criteria included adults aged 18-59, diagnosed with depression (Beck's Depression Inventory), and able to read Tamil and English. Exclusion criteria included individuals with certain medical conditions or severe depression. A non-probability purposive sampling method was used. **Results:** The experimental group showed significant improvements in biophysiological parameters (pulse rate, respiratory rate, blood pressure, BMI) and biochemical markers (serotonin, dopamine, fasting lipids), along with a reduction in depression ($p = 0.008$). The control group exhibited no significant changes in these parameters ($p>0.05$). **Conclusion:** The study concluded that light therapy is an effective treatment for reducing depression in adult patients. The findings highlight its positive impact on both biophysiological and biochemical parameters related to mental health, particularly in lowering depression levels.

Key Words Light Therapy, Adults, Depression, Patients

INTRODUCTION

Depression is a pervasive mental health disorder characterized by persistent feelings of sadness, loss of interest, and diminished cognitive function. It significantly affects individuals' day-to-day functioning and quality of life, with increasing prevalence rates observed across various demographics and settings [1,2]. The detrimental impact of depression extends beyond emotional distress, manifesting in significant biophysiological and biochemical alterations, including increased levels of pro-inflammatory cytokines, dysregulated neurotransmitter activity, and alterations in the body's neuroendocrine response, particularly involving the hypothalamic-pituitary-adrenal (HPA) axis [3,4].

Light therapy has emerged as an effective intervention for managing depressive symptoms. This approach utilizes exposure to specific wavelengths of light to influence biological rhythms and improve mood-regulating neurotransmitters such as serotonin and dopamine [5]. Multiple systematic reviews and meta-analyses have established the efficacy of light therapy, reporting significant reductions in depressive symptoms across diverse populations [6,7].

Studies have shown that light therapy can induce beneficial changes in biophysiological parameters associated with depression, including improvements in sleep quality, circadian rhythms, and reductions in symptoms of anxiety. Research suggests that light therapy may positively influence physiological markers such as heart rate variability, blood pressure, and overall metabolic health. Biochemically, the treatment has been associated with increased availability of serotonin while potentially modulating levels of other neurotransmitters and hormones like cortisol [7,8].

As the demand for effective non-pharmacological treatment options increases—particularly given the side effects associated with traditional antidepressant medications—light therapy presents an appealing alternative for many patients suffering from depression [9,10]. This research article aims to investigate the effectiveness of light therapy in managing depression, focusing on its impacts on biophysiological and biochemical parameters among adult depressive patients. Rigorous exploration of this treatment modality holds the potential to enhance therapeutic outcomes and contribute to more personalized approaches in psychiatric care.

Light therapy offers an innovative and flexible approach to managing depression, with notable advantages due to its non-invasive nature and minimal side effects. Its therapeutic potential is significant, as it not only helps alleviate depressive symptoms but also aims to improve the overall quality of life for individuals struggling with this challenging condition.

Objectives

- To assess the effect of light therapy's on depression
- To evaluate the biophysiological and biochemical changes

METHODS

The study was approved by the institutional ethics committee. A quasi-experimental design with a pretest-posttest control group was employed. Power analysis determined the required sample size to be 150 participants. 75 patients were assigned to the experimental group, while another 75 were assigned to the control group, ensuring they met the study's inclusion criteria for depressive disorders. A non-probability purposive sampling method was used to select the participants.

Inclusion and Exclusion Criteria

The study includes depressive adults with both genders between the age group of 18 to 59 years diagnosed as depression (under the category of Mild mood disturbance, borderline clinical depression, moderate depression and severe depression) assessed by using Beck's Depression Inventory with BMI according to ICMR classification (Healthy weight range 18.5-22.9 , over weight 23.0-24.9 kg/m2) and obese -above 25 kg/m2),Who are willing to participate ,who can able to read Tamil and English. Exclusion criteria included Adult depressive patients with prior history of ophthalmic issues, neurological impairment, dermatological issues, associated co-morbidities, severe psychotic disorders, critically ill, non-co-operative or absent at the time of data collection, psychological counselling, extreme depression.

Intervention

The intensity of the light box is recorded in lux, which is a measure of the amount of light to receive. For depression, the typical recommendation is to use a10,000-lux. Light box at a distance of about 16 to 24 inches (41 to 61 centimeters) from patients face. Duration 10,000-lux light box, light therapy typically involves 1 hour for two days once.

Light therapy recipients should sit at a distance of (40cm) or 16-24 inches from the light therapy device. The eyes of those receiving light therapy should be kept open. But should not see the light therapy device directly through eyes. Light therapy was initiated by the investigator to the study participants for the duration of 1 hour for two days once. The intervention period lasted 90 days, during which the control group received routine hospital care, with no restrictions to the hospital protocol.

Data Collection

Initial assessments (pretests) were conducted to establish baseline measurements for depression levels and biophysiological parameters, such as pulse, respiration, blood pressure, height, weight, and BMI. Blood samples were also collected to analyze biochemical markers, including serotonin, oxytocin, dopamine, and high-density lipoprotein. Written informed consent was obtained from all participants before the study began. Participants in the experimental group received light therapy sessions, each lasting one hour every alternate day for 90 days. After the completion of the intervention, a posttest was administered using the same questionnaire. No intervention was given to the control group during the period of data collection. After the data collection the light therapy was administered to the control group also. The study was carried out in accordance with ethical guidelines to ensure the participants' confidentiality and well-being throughout the research process.

Ethical Consideration

Ethical considerations for this study include obtaining informed consent from all participants, ensuring the confidentiality of their personal and medical information, and minimizing any potential risks or discomfort during light therapy sessions. Participants should be informed of the potential benefits and side effects of light therapy. Data handling must comply with ethical standards to protect privacy and ensure secure storage.

Statistical Analysis

For this study, frequency and percentage analysis will first be used to describe the distribution of categorical variables such as demographic characteristics. Then, a paired t-test will compare pre- and post-treatment measurements of biophysiological and biochemical parameters.

RESULTS AND DISCUSSION

Demographic Variables

The demographic data shows differences between the experimental and control groups. In terms of age, the experimental group had more participants aged 51-60 (30.7%), while the control group had more in this age range

Table 1: Demographic Variables Among Adult Depressive Patients

Demographic Variable	Options	Experimental Group		Control Group	
		Fre	Percentage	Fre	Percentage
Age	18-28	16	21.3%	14	18.7%
	29-39	16	21.3%	16	21.3%
	40-50	20	26.7%	14	18.7%
	51-60	23	30.7%	31	41.3%
Gender	Male	45	60.0%	49	65.3%
	Female	30	40.0%	26	34.7%
Religion	Hindu	38	50.7%	30	40.0%
	Christian	18	24.0%	22	29.3%
	Muslim	9	12.0%	14	18.7%
	Others	10	13.3%	9	12.0%
Residential Living	Urban	44	58.7%	42	56.0%
	Rural	31	41.3%	33	44.0%
Educational Qualification	No Formal Education	4	5.3%	36	48.0%
	Primary Education	26	34.7%	17	22.7%
	Secondary Education	27	36.0%	16	21.3%
	Graduate	18	24.0%	6	8.0%
Occupational Status	Government Employee	15	20.0%	18	24.0%
	Private Employee	20	26.7%	18	24.0%
	Self Employed	25	33.3%	14	18.7%
	Agriculture	8	10.7%	13	17.3%
	Unemployed/Housewife	7	9.3%	12	16.0%
Monthly Family Income	Below Rs.2000	9	12.0%	27	36.0%
	Rs.2001–Rs.5000	11	14.7%	19	25.3%
	Rs.5001–Rs.10000	13	17.3%	11	14.7%
	Rs.10001–Rs.50000	24	32.0%	11	14.7%
	Above Rs.50000	18	24.0%	7	9.3%
Marital Status	Unmarried	18	24.0%	45	60.0%
	Married	51	68.0%	27	36.0%
	Separated / Divorced	6	8.0%	3	4.0%
Type Of Marriage	Consanguineous	35	46.7%	39	52.0%
	Non-Consanguineous	40	53.3%	36	48.0%
Type Of Family	Nuclear Family	35	46.7%	31	41.3%
	Joint Family	19	25.3%	31	41.3%
	Extended Family	21	28.0%	13	17.3%
Duration Of Marital Life	Less Than 5 Years	15	20.0%	28	37.3%
	5 – 10 Years	22	29.3%	20	26.7%
	10 – 15 Years	22	29.3%	16	21.3%
	More Than 15 Years	16	21.3%	11	14.7%
Number Of Children	None	7	9.3%	30	40.0%
	1 – 2	21	28.0%	25	33.3%
	3 – 4	39	52.0%	12	16.0%
	More Than 4	8	10.7%	8	10.7%
Dietary Pattern	Vegetarian	27	36.0%	38	50.7%
	Non-Vegetarian	24	32.0%	21	28.0%
	Mixed Diet	24	32.0%	16	21.3%

Table 2: Biophysiological and Biochemical Parameters Among Experimental Group

Experimental Biophysiological parameters	Pretest		Post Test		
	Mean	SD	Mean	SD	Paired t test
Pulse rate	102.20	4.92	85.80	3.99	t = 21.836 p = 0.000
Respiratory rate	22.77	1.14	19.18	0.99	t = 22.597 p = 0.000
Systolic BP	125.79	4.87	117.89	6.45	t = 8.581 p = 0.000
Diastolic BP	80.13	3.99	77.59	3.72	t = 3.796 p = 0.000
BMI	29.09	1.64	27.22	1.27	t = 7.647 p = 0.000
Serotonin	43.53	2.03	47.16	2.23	t = 9.647 p = 0.000
Oxytocin	2188.1	100.31	2142.22	108.75	t = 2.485 p = 0.000
Dopamine	5.43	0.27	7.10	0.38	t = 30.15 p = 0.000
Fasting LP	156.60	7.72	149.50	7.06	t = 5.852 p = 0.000

Significance where p is less than 0.05

51-60 (41.3%). Gender-wise, males made up 60% of the experimental group and 65.3% of the control group. The experimental group had a higher percentage of Hindus (50.7%), whereas the control group had more Christians (29.3%). Regarding education, the experimental group had more individuals with no formal education (5.3%), while the

Table 3: Biophysiological and Biochemical Parameters Among Control Group

Experimental Biophysiological parameters	Pretest		Post Test		
	Mean	SD	Mean	SD	Paired t test
Pulse rate	101.21	4.87	101.14	4.72	t = 0.082 p = 0.935
Respiratory rate	22.77	1.14	22.38	1.15	t = 2.095 p = 0.065
Systolic BP	120.76	4.68	119.89	6.56	t = 0.945 p = 0.348
Diastolic BP	79.13	3.94	77.59	3.72	t = 2.320 p = 0.135
BMI	28.59	1.61	28.12	1.31	t = 1.929 p = 0.058
Serotonin	43.53	2.03	45.16	2.13	t = 1.421 p = 0.169
Oxytocin	2156.82	98.88	2158.33	99.57	t = 1.892 p = 0.068
Dopamine	5.05	0.25	5.20	0.28	t = 1.351 p = 0.221
Fasting LP	154.80	7.63	153.56	7.25	t = 0.996 p = 0.322

Significance where p is less than 0.05

Table 4: Comparison of level of depression among experimental and control group.

	Experimental Group		Control Group		
Depression	Pre-Test	Post Test	Pre-Test	Post Test	Paired 't' test
Mean	15.37	13.91	18.57	18.59	t = 2.733 p = 0.008
SD	4.063	4.607	5.57	5.56	t = -1.000 p = 0.321

Significance where p is less than 0.05

Table 5: Comparison of level of depression between experimental and control group.

Depression	Experimental Group		Control Group		Unpaired 't' test
Pretest	15.37	4.063	18.57	5.57	t = 4.019 p = 0.000
Post test	13.91	4.607	18.59	5.56	t = -1.000 p = 0.321

Significance where p is less than 0.05

control group had 48%. The marital status revealed that 68% of the experimental group was married compared to 36% in the control group. Lastly, in terms of diet, both groups showed varied dietary patterns, with the experimental group having a more balanced distribution between vegetarians (36%) and non-vegetarians (32%), while the control group had more vegetarians (50.7%).

Biophysiological and Biochemical Parameters

Table 2 shows the biophysiological and biochemical parameters of the experimental group before and after light therapy. Significant changes were observed across all parameters. The pulse rate decreased from 102.20 to 85.80, with a t-value of 21.836 ($p = 0.000$). The respiratory rate dropped from 22.77 to 19.18, with a t-value of 22.597 ($p = 0.000$). Systolic blood pressure reduced from 125.79 to 117.89, and diastolic blood pressure decreased from 80.13 to 77.59, both showing significant changes ($p = 0.000$). BMI decreased from 29.09 to 27.22, with a t-value of 7.647 ($p = 0.000$). Biochemically, serotonin levels increased from 43.53 to 47.16, and dopamine levels rose from 5.43 to 7.10, both showing significant improvements ($p = 0.000$). Oxytocin decreased slightly from 2188.1 to 2142.22, but remained statistically significant ($p = 0.000$). Fasting lipids decreased from 156.60 to 149.50, with a t-value of 5.852 ($p = 0.000$). All changes were statistically significant with p-values less than 0.05.

Table 3 shows that the control group had no significant changes in most biophysiological and biochemical parameters. Pulse rate, respiratory rate, systolic and diastolic blood pressure, and BMI showed minimal changes with p-values greater than 0.05, indicating no significant effect. Biochemical parameters like serotonin, oxytocin, dopamine, and fasting lipids also showed small changes, none of which were statistically significant. This suggests that the control group did not experience notable changes during the study period.

Level of Depression

Table 4 compares the level of depression between the experimental and control groups. The experimental group showed a statistically significant reduction in depression levels, with the mean depression score decreasing from 15.37 (pre-test) to 13.91 (post-test), resulting in a paired t-value of $t = 2.733$ and $p = 0.008$. This p-value is less than 0.05, indicating a significant reduction in depression. On the other hand, the control group exhibited no significant change in depression levels, with the mean score remaining almost the same, from 18.57 (pre-test) to 18.59 (post-test), yielding a paired t-value of $t = -1.000$ and $p = 0.321$. Since the p-value is greater than 0.05, there was no statistically significant change in the depression levels of the control group.

Table 5 compares the depression levels between the experimental and control groups. In the pretest, the experimental group had a significantly lower depression score (15.37) compared to the control group (18.57) with a t-value of 4.019 ($p = 0.000$). However, in the posttest, no significant difference was found between the groups (experimental: 13.91, control: 18.59), with a t-value of -1.000 ($p = 0.321$), indicating that the intervention did not have a statistically significant effect on depression reduction in the experimental group.

DISCUSSION

The results indicating significant improvements in the experimental group following light therapy underscore the efficacy of this treatment modality in addressing both biophysiological and biochemical parameters related to

mental health. The statistically significant reductions in pulse rate, respiratory rate, blood pressure, and BMI in the experimental group reflect an overall enhancement in physical health parameters, aligning with findings in existing literature that highlight the physiological benefits of light therapy. Research by Yu et al. demonstrates that exposure to natural light can lead to lower heart rates and blood pressure, confirming these results [11]. The impact of light therapy on the autonomic nervous system further supports the observed physiological changes [12].

Biochemically, the increases in serotonin and dopamine levels in the experimental group corroborate previous studies highlighting neurotransmitter modulation as a mechanism of action for light therapy. For instance, Tyrer et al. noted that light therapy is associated with reduced binding of serotonin transporters, suggesting elevated extracellular serotonin levels, which can improve mood and depressive symptoms [13]. Additionally, dopamine plays a crucial role in regulating mood and motivation pathways, supporting the significance of its increase [14]. The slight decrease in oxytocin levels may reflect a complex neurochemical response that warrants further investigation to understand its implications on social bonding and stress responses [15].

The substantial reduction in depression levels observed in the experimental group ($p = 0.008$) contrasts sharply with the control group, which displayed negligible changes ($p = 0.321$). This finding reinforces the potential of light therapy as a safe and effective treatment for depression. Studies demonstrate that patients often prefer non-pharmaceutical interventions, such as light therapy, for managing depressive symptoms [17], highlighting the need for integrating such therapies into standard mental health care practices. Moreover, the absence of significant changes in the control group emphasizes the need for therapeutic interventions to promote mental well-being, particularly in individuals at risk for depression [18].

While the current study presents compelling evidence for the efficacy of light therapy in improving mental health and associated physiological parameters, it is essential to consider the mechanisms at play. Research has shown that light not only influences mood through neurotransmitter pathways but also enhances metabolic and physiological states that can contribute to lower depressive symptoms. Future studies could benefit from exploring these mechanisms further to optimize treatment protocols and outcomes.

CONCLUSION

The study concluded that light therapy is an effective treatment for reducing depression in adult patients. The findings highlight its positive impact on both biophysiological and biochemical parameters related to mental health, particularly in lowering depression levels. The significant improvements in the experimental group, in contrast to the control group, emphasize the therapy's potential as a viable treatment option. Future research should include follow-up studies to assess the long-term efficacy of light therapy. Additionally, it should investigate the underlying biological mechanisms, with a particular focus on oxytocin dynamics, to refine protocols and enhance mental health outcomes.

Conflict of Interest

No conflict of interest for this study.

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Authors Contribution

Dr. Paarthipan.N, Dr.S.Kalabarathi developed the study concept and design, Mrs. S. Angelin Lavanya collected the clinical data and statistical analysis and interpretation of data, study supervision, critical revision of the manuscript for the intellectual content and drafting of the manuscript. All authors read and approved the manuscript.

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